CLAIMS

1. A method for reactivating at least partially deactivated zeolite catalyst in one or more reaction zones in a reaction section where reactions are carried out in liquid phase or partially liquid phase for the production of alkyl aromatic compounds wherein said alkyl aromatic compounds are produced by reacting at least one feed olefin with at least one feed aromatic, said catalyst reactivation process comprising the steps of:
   (a) stopping or substantially reducing at least one selected feed to the reaction zone(s); and introducing a catalyst reactivating agent into said reaction zone(s) at a weight hourly space velocity between about 0.02 hr^{-1} and 200 hr^{-1}; and raising the reaction zone(s) temperature(s) to temperature(s) above the normal reaction zone(s) operating temperature(s) by about 10°C to 200°C;
   (b) allowing said at least partially deactivated catalyst to be at least partially reactivated in said reaction zone(s) at said elevated temperature(s) over a period of time between 1 hour and 30 days;
   (c) terminating flow of said catalyst reactivating agent; and re-establishing normal reaction zone(s) operating conditions and said selected reactor charge(s); and
   (d) resuming production of said alkyl aromatic compounds in said reaction zone(s).
2. The method of claim 1 further comprising removing catalyst deactivating materials, catalyst contaminants and process contaminants by distillation, purging, selective adsorption with a suitable adsorbent or combinations thereof.
3. The method of claim 1 wherein said catalyst reactivation steps are capable of being performed while simultaneously conducting substantially all other operations in a facility for producing alkyl aromatic compounds.
4. The method of claim 1 wherein said catalyst reactivating agent comprises an aromatic stripping stream consisting essentially of at least one member selected from the group consisting of feed aromatics, alkyl aromatic products and process byproducts.
5. The method of claim 4 wherein said aromatic stripping stream is introduced at a weight hourly space velocity ranging from about 0.2 hr^{-1} to about 50 hr^{-1} and said

temperature is raised from about 20°C to 140°C above said normal operating temperature and wherein said period of time is from about 6 hours to about 7 days.

6. The method of claim 1 wherein said period of time is from 12 hours to 4 days.
7. The method of claim 4 wherein said stripping stream comprises benzene.
8. The method of claim 2 wherein said catalyst contaminants comprise at least one member selected from the group consisting of oligomers and/or other heavy compounds formed from feed olefins, basic materials, polar compounds, nitrogen-containing materials and fragments and/or derivatives of the aforementioned compounds.
9. The method of claim 8 wherein heavier contaminants are purged at a bottom portion of a distillation column and wherein lighter contaminants and oligomer fragments are separated from said reactivating agent in one or more distillation columns and are removed therefrom in light end purges at a top portion of said distillation columns.
10. The method of claim 8 wherein desorbed contaminants are removed from said reactivating agent by selective adsorption by a suitable adsorbent comprising at least one member selected from the group consisting of acidic clay, zeolites, zeolite catalysts, molecular sieves, silicates, aluminas, activated aluminas, activated carbon, silica gel and ion exchange resins.
11. The method of claim 10 further comprising regenerating a spent adsorbent component, wherein said regeneration is capable of being carried out while simultaneously conducting substantially all other operations in a facility for producing alkyl aromatic compounds.
12. The method of claim 11 wherein said adsorbent regeneration further comprises subjecting said adsorbent, under elevated temperatures, to a flow of inert material comprising at least one member selected from the group consisting of nitrogen, air, natural gas, liquefied petroleum gas, methane, ethane, propane, steam, n-pentane, cylcopentane, n-hexane, cyclohexane, benzene, toluene and xylene.
13. The method of claim 11 wherein said absorbents are regenerated by displacing said adsorbed contaminants by other compounds that are adsorbed on said adsorbent preferentially over said contaminants.

14. The method of claim 1 wherein said production of alkyl aromatic compounds comprises at least the steps of:
    (a) reacting feed aromatics and feed olefins in a reaction section to produce a desired alkyl aromatic compounds, recoverable byproducts and unrecoverable byproducts;
    (b) isolating and recovering in a separation section said desired alkyl aromatic product;
    (c) recovering and recycling in said separation section unconverted feedstock and said recoverable byproducts; and
    (d) isolating and purging said unrecoverable products.
15. The method of claim 14 wherein said reaction section comprises an alkylation zone for reacting said feed aromatics and said feed olefins over a zeolite alkylation catalyst to produce a first alkyl aromatic component, recoverable byproducts, and unrecoverable byproducts, and a transalkylation zone for reacting recoverable byproducts with feed aromatics over a zeolite transalkylation catalyst to form additional alkyl aromatic component, recoverable byproducts and unrecoverable byproducts; and wherein the alkylation zone and the transalkylation zone each comprises one or more reaction zones.
16. The method of claim 15 wherein said alkylation zone and transalkylation zone are arranged sequentially, in series, with said alkylation zone located upstream and said transalkylation zone located downstream.
17. The method of claim 15 wherein said alkylation zone and transalkylation zone are arranged sequentially in series, with said transalkylation zone located upstream and said alkylation zone located downstream
18. The method of claim 15 wherein said alkylation zone and transalkylation zone are arranged in parallel.
19. The method of claim 14 wherein said reaction section further comprises an isomerization zone for the production of dialkyl aromatic compounds wherein said isomerization zone comprises one or more reaction zones.
20. The method of claim 14 wherein said reaction section comprises a combined alkylation/transalkylation zone for reacting said feed aromatics, said feed olefin and

said recycle recoverable byproducts to form alkyl aromatic compounds, recoverable byproducts and unrecoverable byproducts, said reaction taking place in the presence of a zeolite catalyst suitable for alkylation reactions and transalkylation reactions wherein said alkylation/transalkylation zone comprises one ore more reaction zones.

21. The method of claim 14 wherein said reaction section comprises a combined alkylation/isomerization zone for reacting said feed aromatics, said feed olefin and said recycle recoverable byproducts to form alkyl aromatic compounds, recoverable byproducts and unrecoverable byproducts, said reaction taking place in the presence of a zeolite catalyst suitable for alkylation reactions and isomerization reactions; wherein said combined alkylation/isomerization zone comprises one or more reaction zones.
22. The method of claim 1 wherein said feed olefin consists essentially of olefins containing 2 to 4 carbon atoms and said feed aromatics consist essentially of at least one member selected from the group consisting of benzene, toluene, ethylbenzene, xylenes, cumene, n-propyl benzene and butylbenzene isomers.
23. The method of claim 22 wherein said olefin feed is selected from the group consisting of ethylene and propylene and the aromatic feed consists essentially of benzene.
24. The method of claim 1 wherein said zeolite catalyst is selected from the group consisting of zeolite beta, zeolite Y, zeolite omega, ZSM-5, ZSM-12, MCM-22, MCM-36, MCM-49, MCM-56, MCM-58, MCM-68, Faujasite, Mordenite, porous crystalline magnesium silicates and zirconium phosphate.
25. A method for reactivating at least partially deactivated zeolite catalyst used in one or more reaction zones in a reaction section where reactions are carried out in liquid phase or partially liquid phase for the production of alkyl aromatic compounds by reacting at least an olefin containing from 2 to 5 carbon atoms with at least an aromatic compound, said catalyst reactivation process comprising the steps of:
    (a) stopping or substantially reducing at least one selected feed to the reaction zone(s); and introducing a catalyst reactivating agent into said reaction zone(s) at a weight hourly space velocity between about 0.02 hr^{-1} and 200 hr^{-1}; and raising the reaction zone(s) temperature(s) to temperature(s)

above the normal reaction zone(s) operating temperature(s) by about 10°C to 200°C;

(b) allowing said at least partially deactivated catalyst to be at least partially reactivated in said reaction zone(s) at said elevated temperature(s) over a period of time between 1 hour and 30 days;

(c) terminating flow of said catalyst reactivating agent; and re-establishing normal reaction zone(s) operating conditions and said selected reactor charge(s); and

(d) resuming production of said alkyl aromatic compounds in said reaction zone(s).

26. The method of Claim 25 wherein said olefin reactant comprises from 2 to 4 carbon atoms.

27. A method for reactivating zeolite catalyst, which catalyst is at least partially deactivated with feedstock contaminants, used in one or more reaction zones in a reaction section where reactions are carried out in liquid phase or partially liquid phase for the production of alkyl aromatic compounds by reacting at least an olefin containing from 2 to 5 carbon atoms with at least an aromatic compound, said catalyst reactivation process comprising the steps of:

(a) stopping or substantially reducing at least one selected feed to the reaction zone(s); and introducing a catalyst reactivating agent into said reaction zone(s) at a weight hourly space velocity between about 0.02 hr^{-1} and 200 hr^{-1}; and raising the reactor temperature to a temperature above the normal reaction zone(s) operating temperature(s) by about 10°C to 200°C;

(b) allowing said at least partially deactivated catalyst to be at least partially reactivated in said reaction zone(s) at said elevated temperature(s) over a period of time between 1 hour and 30 days;

(c) terminating flow of said catalyst reactivating agent; and re-establishing normal reaction zone(s) operating conditions and said selected reactor charge(s); and

(d) resuming production of said alkyl aromatic compounds in said reaction zone(s).

28. The method of Claim 27 wherein said feedstock contaminants are selected from the group consisting of basic materials, polar compounds, nitrogen-containing compounds and mixtures thereof.

29. A method for reactivating zeolite catalyst, which catalyst is at least partially deactivated with oligomers and/or other heavy compounds formed from olefins contained in the feedstock, used in one or more reaction zones in a reaction section in which the reactions are carried out in liquid phase or partially liquid phase for the production of alkyl aromatic compounds by reacting at least an olefin containing from 2 to 5 carbon atoms with at least an aromatic compound, said catalyst reactivation process comprising the steps of:

    (a) stopping or substantially reducing at least one selected feed to the reaction zone(s); and introducing a catalyst reactivating agent into said reaction zone(s) at a weight hourly space velocity between about 0.02 hr^{-1} and 200 hr^{-1}; and raising the reaction zone temperature(s) to temperature(s) above the normal reaction zone(s) operating temperature(s) by about 10°C to 200°C;

    (b) allowing said at least partially deactivated catalyst to be at least partially reactivated in said reaction zone(s) at said elevated temperature(s) over a period of time between 1 hour and 30 days;

    (c) terminating flow of said catalyst reactivating agent; and re-establishing normal reaction zone(s) operating conditions and said selected reactor charge(s); and

    (d) resuming production of said alkyl aromatic compounds in said reaction zone(s).